**T₂ Relaxation Assessments of Kidney and Liver Disease in the PCK Rat Model of Autosomal Recessive Polycystic Kidney Disease (ARPKD)**

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**Introduction:** Autosomal Recessive Polycystic Kidney Disease (ARPKD) is a multiorgan pediatric disease that manifests as progressively increasing renal cysts as well as liver biliary dilatation and congenital hepatic fibrosis. ARPKD kidney disease results in kidney failure in 40-50% of ARPKD children1. With improved care of the kidney disease, an increasing number of ARPKD children are now experiencing liver dysfunction which may eventually require transplant. Unfortunately, no tools are currently available to effectively monitor ARPKD kidney and liver disease progression which directly limits therapeutic trials2. We are currently developing quantitative MRI assessments of ARPKD kidney and liver disease using the PCK rat model that exhibits both kidney and liver diseases similar to human ARPKD3,4,5. In this study, we are exploring the potential of T₂ relaxation assessments to assess renal cystic burden and hepatobiliary dilatation while also limiting the potentially variable effects of tissue perfusion.

**Materials and Methods:** Three 4-month-old male PCK rats were anesthetized with isoflurane and positioned at isocenter in a 7T Bruker Biospec MRI scanner. Axial kidney and liver images of three 4-month-old male PCK rats were obtained with a respiratory-gated, multiecho RARE acquisition (TR=820ms, TE = 10ms-60ms, 6 echoes, resolution = 312 x 312 x 1500μm). T₂ relaxation maps of each animal’s kidney and liver were generated via linear least squares fitting of conventional monoexponential decay models using either 1) all 6 echo images (TE=10-60ms), or 2) last 4 echo images (TE = 30-60ms). An ROI analysis was used to identify potential biexponential decay effects suggestive of tissue perfusion. A histogram analysis was then performed to establish consistent thresholds and to generate separate compartments for the kidney (cysts vs. normal kidney parenchyma) and liver (bile ducts vs. normal liver parenchyma) based on these T₂ estimates. Diseased and normal tissues were then segmented and mean T₂ values of each tissue compartment were calculated for each animal.

**Results:** Representative T2-weighted RARE images of PCK rat kidney and liver are shown in Fig. 1. As expected, biexponential characteristics suggestive of tissue perfusion were observed for the PCK rat liver and kidney data (Fig. 2). Based on these results, a histogram analysis (data not shown) was performed on the T₂ maps from the TE = 30-60ms data to establish consistent segmentation thresholds of 100ms (liver) and 130ms (kidney) for all imaging slices. Mean T₂ values for each tissue compartment are shown in Fig. 3. Mean T₂ values for all animals / slices are: liver parenchyma / bile ducts = 51ms / 175 ms; kidney parenchyma / cysts = 83ms / 184ms.

**Discussion and Conclusions:** We have developed an initial MRI methodology to characterize ARPKD kidney and liver disease progression in PCK rats in vivo using T₂ relaxation assessments. These preliminary results suggest that elimination of early echoes (TE=10-30ms) can reduce the biexponential characteristics of the T₂ decay curves thereby limiting the impact of tissue perfusion. As a result, these T₂ relaxation assessments may provide a consistent assessment allowing semiautomatic segmentation of diseased regions of both kidney and liver in ARPKD. Further studies are needed to confirm that the biexponential characteristics are indeed due to tissue perfusion. In addition, histological verification of the cystic burden and biliary dilatation obtained from this T2 methodology are pending.


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